Appl. No. 10/814,408
Atty. Docket: 2002B139/2
Amendment dated May 21, 2007
Reply to Office Action dated March 21, 2007

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REMARKS/ARGUMENTS

Claim Status and Request for Reconsideration

Reconsideration of this application is requested. The claims presented for reconsideration are claims 24 and 30-33. No amendments have been made.

Claim Rejections - 35 U.S.C § 103

Claims 24 and 30-33 were rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 2,892,773 to Hirsch *et al.* (hereinafter "Hirsch"), in view of U.S. Patent No. 4,092,722 to Hofferber *et al.* (hereinafter "Hofferber"), and further in view of U.S. Patent No. 3,213,014 to Atkinson *et al.* (hereinafter "Atkinson"). This rejection is traversed and reconsideration is requested.

This invention is direct to an oxygenates to olefins fluidized bed reactor apparatus for converting an oxygenate feed to olefins in a riser reactor. The apparatus can include an oxygenate feed line communicating with a riser reactor feed inlet to the riser reactor, with the riser reactor also including a riser reactor outlet. A disengaging vessel can receive the riser reactor effluent and can separate at least some of the solid catalyst particles that are present in the effluent. The disengaging vessel can have an outlet at an upper portion of the vessel for removing olefins. A catalyst circulation line can run downward from a lower portion of the disengaging vessel to a lower portion of the riser reactor. The apparatus can also include a regenerator that has a lower inlet for introducing a regeneration medium and an upper outlet for regenerator flue gas. The regenerator can include a first catalyst transport line running downwardly from a lower portion of the disengaging vessel to a regenerator catalyst inlet on the regenerator. Also included on the regenerator is a second catalyst transport line extending downwardly from a regenerated catalyst outlet on the regenerator, which can intersect with a lift gas riser. The lift gas riser can have an upper outlet at the disengaging vessel and a lower lift gas inlet.

The apparatus of this invention is configured such that the amount of coke on catalyst can be more easily controlled during operation. As discussed in Applicants' specification, catalyst activity is a function of the amount of coke on the catalyst. In general, the more coke on the

catalyst, the lower the activity. However, a certain amount of coke is desirable in order to increase the selectivity of the catalyst to form light olefins such as ethylene and propylene from the oxygenate feed. Either the amount of coke on each of the catalyst particles can be controlled through a partial regeneration process, or the overall coke composition can be averaged through a total regeneration process. In this invention, the overall coke composition in the riser reactor portion of the apparatus can be affected by the use of a regenerator catalyst circulation valve and a catalyst circulation control valve.

This invention also concerns the ability to affect space velocity through the reactor portion of the apparatus. This can be accomplished, at least in part, by appropriately controlling catalyst circulation from the disengaging vessel to the riser reactor. Control of catalyst circulation in this manner can make a significant impact on selectivity to specific olefin product formation and on conversion.

Applicants' invention can be more fully described by the particular embodiment shown in Figure 1. In that embodiment, regenerated catalyst that is returned by way of lift gas riser 32 to an upper portion of disengaging vessel 34 is combined with unregenerated catalyst that exits riser 26. The combination of regenerated and unregenerated catalyst is circulated through a bypass loop 36, with the combination of regenerated and unregenerated catalyst contacting feed in from leaving feed inlet valve 28. The combination of regenerated catalyst and unregenerated catalyst is manipulated by an appropriate control valve arrangement 44 and 48 to provide the desired catalyst activity. The amount of coke on the catalyst circulated to the riser and the amount of catalyst entering the riser are controlled by the use of temperature controller 30 and pressure controller 38 on a line connecting the regenerator and disengaging vessel and on a line 36 connecting the disengaging vessel to the feed inlet location of the riser.

The cited Hirsch patent discloses a type of fluidized bed reactor that includes riser reactors 10a, 10b. The Hirsch device, however, differs from the claimed invention in that Hirsch does not have a regenerator catalyst circulation control valve means for controlling the passage of catalyst from a regenerated catalyst outlet to a lift gas riser, and being manipulated as a function of riser reactor temperature. The only control valves that control catalyst flow to and from the regenerator are valves 60, 62, 64, and 66. The valves 60 and 62 control flow of catalyst

to a lift gas riser 58, but the lift gas riser does not intersect with a regenerated catalyst outlet as required by the claims. An even more significant difference between Hirsch and the claimed invention, however, is that the Hirsch control valves are controlled as a function of pressure, not temperature, as required by the claims.

Although the Hirsch control valves are controlled as a function of pressure rather than temperature, it has, nevertheless, been alleged in the Office Action that the use of temperature control means to control flow from the regenerator to the lift gas riser as a function of temperature would have been obvious, "because controlling the flow of unregenerated catalyst from the regenerator to the riser reactor according to a measured temperature of the riser reactor allows for the automatic maintenance of an approximately constant temperature both in the riser and in the reactor vessel or regenerator bed, as taught by Hofferber et al. (column 2, lines 20-33)." Office Action at page 4. Although the Hofferber flow control means is operated as a function of temperature as noted in the Office Action, it would not have been obvious to one of ordinary skill in the art to merely substitute the temperature type of flow control means of Hofferber for the Hirsch pressure type flow control means, because it would be essentially, if not entirely, impossible to control flow back and forth between Hirsch's regenerator 40 and hopper 16 using the type of flow control device disclosed by Hofferber.

As described at column 4, lines 56-61, of Hirsch, "[e]ach of slide valves 60 and 62 and control valves 68 and 70, as well as differential pressure controller 47 is connected to the timer 48 and actuated thereby in accordance with the desired schedule to control the rate and direction of flow of fluidized solid particles between the hopper 16 and regenerator 40." Therefore, the Hirsch valve system is used to control not just the rate of flow but also the direction of flow. This is not the purpose of the temperature controlled flow valves of Hofferber. The Hofferber valves work to control temperature between riser and reactor. To substitute the Hofferber valve system with the pressure type valve system in Hirsch would destroy the ability to control direction of flow between the Hirsch regenerator and hopper. Moreover, installing a temperature type control valve system in the Hirsch lift gas riser 58 would also not work at controlling temperature between regenerator and reactor. This is because Hirsch's lift gas riser flows into a hopper, not into a reactor. Therefore, even in the unlikely even that the Hofferber type control

valve arrangement could be installed on lift gas riser 58, one of ordinary skill in the art would have no way, and the cited prior art references provide no teaching or suggestion as to how, to control temperature of the Hirsch reactors 10a and 10b through flow of catalyst from the regenerator.

The Hirsch device further differs from the claimed invention in that Hirsch also does not have a catalyst circulation control valve that is capable of controlling circulation of catalyst from the disengaging vessel to the riser reactor, as a function of the difference in pressure between an upper portion of said riser reactor and a lower portion of the riser reactor. The portion of the Hirsch apparatus that most closely corresponds to a disengaging vessel is the hopper 16. Catalyst flow from that vessel to the riser reactors 10a and 10b is controlled by slide valves 28a and 28b. These valves are not shown to have any type of control function, no less the temperature control function attributed to Applicants' claimed means.

At page 4 of the Office Action, it has also been alleged that incorporating a catalyst circulation control valve means that operates as a function of differential pressure in a manner to control circulation of catalyst from Hirsch's disengaging vessel to his riser reactors would have been obvious in view of the control means shown in Atkinson. According to the Office Action, the reason that such a modification of Hirsch would have been obvious would be "because the differential signal obtained from the pressure sensors makes it possible to calculate the total feed material flow rate through the riser, thereby automating the control of catalyst flow to the riser, as taught by Atkinson et al. (*See* column 3, lines 1-6)." Id. The allegation that incorporating an Atkinson type of flow control means into the Hirsch device is unfounded, since the Atkinson flow control means would have no useful function in the Hirsch apparatus.

The Atkinson flow control means functions to control flow of catalyst from the regenerator 13 to the reactor 11 by way of a transfer conduit 18, and to control the flow of air into the regenerator 13. The Atkinson flow control means operates as a function of differential pressure and multiple temperatures within the transfer conduit 18, and also as a function of the rate of flow of steam to the transfer conduit and hydrocarbon injection into the transfer conduit. There is no place in the Hirsch apparatus in which the Atkinson flow control means can be used. One main reason is that the flow of catalyst from Hirsch's regenerator is already controlled by

differential pressure control means to control flow and pressure between Hirsch's regenerator and hopper. The only valve means in Hirsch that controls flow from the disengaging vessel to the riser reactors 10a and 10b are valves 28a and 28b. There is no reason to control the valves 28a and 28b as a function of differential pressure, and there is nothing disclosed in Atkinson that would suggest controlling catalyst flow through the Hirsch valves 28a and 28b. Therefore, the use of catalyst circulation control valve means for controlling circulation of catalyst from a disengaging vessel to a riser reactor as a function of pressure would not have been obvious in view of what is disclosed in either Hirsch or Atkinson.

To allege that modifying the Hirsch apparatus to include a regenerator catalyst circulation control valve means and a catalyst circulation control valve means in the manner claimed by applicants would have been obvious to one of ordinary skill in the art has no factual support. Hirsch does not have such means and the type of flow control means shown in Hofferber and Atkinson cannot be used in Hirsch, because both the Hofferber and Atkinson control means cannot be combined with the Hirsch apparatus nor have any useful function in the Hirsch device. Accordingly, the combination of references does not suggest the claimed invention.

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CONCLUSION

Having demonstrated that the cited references fail to disclose or suggest the invention as claimed, and all other formal issues having now been fully addressed, this application is believed to be in condition for allowance. Accordingly, Applicants request early and favorable reconsideration in the form of a Notice of Allowance.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated, since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response. Please charge any deficiency in fees or credit any overpayments to Deposit Account No. 09-0528 (Docket #: 2002B139/2).

Respectfully submitted,

Date: 5/21/07

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